Active Rehabilitation and Physical Therapy During Extracorporeal Membrane Oxygenation While Awaiting Lung Transplantation

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Lung Transplantation

Lung transplantation is an important therapeutic option for many severe respiratory diseases associated with a high mortality.

**Indications for Lung Transplantation**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>2008 Transplants (%)*</th>
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</thead>
<tbody>
<tr>
<td>Idiopathic Pulmonary Fibrosis</td>
<td>33.5</td>
</tr>
<tr>
<td>Emphysema/COPD</td>
<td>28.6</td>
</tr>
<tr>
<td>Cystic Fibrosis</td>
<td>13.7</td>
</tr>
<tr>
<td>Alpha – 1 – Antitrypsin Deficiency</td>
<td>2.9</td>
</tr>
<tr>
<td>Idiopathic Pulmonary Arterial Hypertension</td>
<td>1.8</td>
</tr>
<tr>
<td>Congenital Disease</td>
<td>0.3</td>
</tr>
</tbody>
</table>

*U.S. Organ Procurement and Transplantation Network and the Scientific Registry of Transplant Recipients 2009 Annual Report*
ECMO and Lung Transplantation

• Patients with end-stage respiratory disease are at a high risk for critical illness, thus limiting their transplant candidacy.

• Extracorporeal membrane oxygenation (ECMO) may be necessary as a bridge to transplantation in the most critically ill of these patients who become refractory to maximal conventional therapies.

• Poor outcomes have been reported with ECMO as a pre-operative bridge to lung transplantation.
ECMO and Lung Transplantation

• Underlying muscle strength and deconditioning likely contribute to low survival rates in patients transplanted from ECMO.

• To ameliorate the negative effects of pre-transplant deconditioning, our multidisciplinary team developed a strategy to actively rehabilitate patients while using ECMO as a bridge to transplantation.
Methods

• In our Pediatric Intensive Care Unit, we initiated an ambulatory ECMO program for an adolescent with end-stage cystic fibrosis and respiratory failure.

• The clinical care team determined that ECMO was necessary to allow for pre-transplant rehabilitation.

• Program development was initiated by a multidisciplinary team including pediatric intensivists, lung transplant pulmonologists, respiratory therapists, ECMO specialists, nurses, occupational therapists, and physical therapists.
Patients and Main Results

• We describe two patients (ages 17 and 24 years) with refractory respiratory failure due to end-stage cystic fibrosis who had previously been denied lung transplantation at their referring centers.

• Each patient:
  – was cannulated for venovenous (VV) ECMO with a double lumen internal jugular venous cannula (Avalon Labs; Rancho Domingo, CA).
  – underwent rehabilitation while on VV ECMO awaiting transplant.
  – received tracheostomy to facilitate weaning of sedation and mechanical ventilation within 24 hours of ECMO cannulation.
  – ambulated while on ECMO within 1 week.
  – underwent successful bilateral sequential lung transplantation and was subsequently decannulated from ECMO within hours.
  – was discharged from the ICU less than one week post-transplant.
  – was discharged home without the need for transition to a rehabilitation facility (at 31 and 32 days post-transplant).
Ambulation while on ECMO
Discussion

• In the setting of lung transplantation, deconditioning may be an important cause of both morbidity and mortality.
• Pre-transplant conditioning may be improved via rehabilitation and active conditioning in critically ill patients on ECMO.
• A potential mechanism to enhance the mobility of ECMO patients is single vessel internal jugular vein cannulation.
• To actively rehabilitate and ambulate patients being treated with ECMO, substantial planning is required by a dedicated multidisciplinary team (including physicians, nurses, respiratory therapists, ECMO specialists, physical therapists, and occupational therapists).
Conclusions

• Ambulation on ECMO can be safe in critically ill patients awaiting lung transplantation.

• Pre- and post-operative morbidity and mortality may be decreased when ambulatory ECMO is used as a bridge to lung transplantation.

• Rehabilitation and re-conditioning on ECMO may decrease ICU length of stay following lung transplantation.

• This innovative approach to ambulation and activity on ECMO has potential implications for the management of all critically ill ECMO patients.

• Future investigation is needed to further assess the impact of increased activity and active physical therapy on the morbidity and mortality of ECMO patients.
References


